

A significant range extension for the Border Ranges Leaf-tailed Gecko, *Saltuarius swaini* (Wells & Wellington, 1985) (Reptilia: Carphodactylidae)

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ABSTRACT

The recent discovery of *Saltuarius swaini* on Mt Glorious is unexpected due to the site's proximity to a major city. It extends the species' range 80 km north of the nearest known population. Genetic analyses suggests that this is a natural population that has been isolated from the other sequenced, south-east Queensland *S. swaini* populations for an extended period. The species has a limited occurrence on Mt Glorious where it is apparently absent from extensive tracts of suitable rainforest habitat. The rainforest herpetofauna of Mt Glorious is broadly similar to, but more impoverished than, that of the larger southern rainforest blocks of the Border and Main Ranges.

□ leaf-tailed gecko, *Saltuarius swaini*, range extension, rainforest, south-east Queensland, Australia.

The distribution of *Saltuarius swaini* (Wells & Wellington, 1985) is largely associated with rainforests and adjacent wet sclerophyll forests on basalt formations of the Main Range, Focal Peak and Mt Warning-Tweed shield volcanoes (Couper *et al.* 2008). These occur between latitudes 27° 53' S–28° 48' E and are of late Oligocene to early Miocene age (25.5–20.5 mya; Ewart *et al.* 1987; Willmott 2004). Couper *et al.* (2008) reported Mt Tamborine (27° 55' S, 153° 10' E) as the northern limit of this species' distribution and although there was suitable habitat in the D'Aguiar Range,

80 km to the north, there were no records from this area.

On the evening of the 16th September 2016, B. Revell was head-torching for frogs in rainforest on Mt Glorious in the D'Aguiar Range (27° 20' S, 152° 46' E), west of Brisbane, and found a large leaf-tailed gecko (Fig. 1) of the genus *Saltuarius* Couper *et al.*, 1993, on the trunk of a Strangler Fig Tree *Ficus* sp. The site was revisited four days later and two additional geckos were found and photographed *in situ*. Subsequent examination of these images showed that the geckos were morphologically similar to *S. swaini*.



FIG. 1. *Saltuarius swaini*, Mt Glorious. (Image: Ben Revell).

This discovery was unexpected because it occurred in a well-visited area, close to a major city. The observation raised several questions. Is this a population of *S. swaini* or an undescribed species? If *S. swaini*, is this population natural or a recent introduction? To address these questions, additional surveys were conducted to examine the habitat, obtain close-up photographs of the animals, and collect tissue samples (tail tips) for genetic analyses.

METHODS AND RESULTS

Observations. The initial photographs taken on the 20th September 2016 were of two adult-sized *Saltuarius*, both with regrown tails, high on the trunks of separate trees. Whilst the form and pattern of these geckos was consistent with that of *S. swaini*, the images were not sufficiently clear to show any of the finer diagnostic characters. The site was revisited (by BR) four additional times (21st September, 3rd October, 25th October and 31st October, 2016) and 6

geckos were sighted. An individual was found low enough on the trunk of a fig tree to take a series of close-up images. These showed that the gecko had low, conical flank tubercles and a heterogeneous mix of small and large scales above the supralabials, both of which are diagnostic characters for *S. swaini* (see Couper *et al.* 1993). The site was visited again on the 5th of November and the 14th of November to obtain tail tip samples from three individuals. During these surveys, at least 10 individual geckos were identified from areas proximate (i.e., within 250 m) to the site where leaf-tailed geckos were first seen. On the 15th of November, two adult leaf-tailed geckos were observed on a large fig tree approximately 2 km from the original site.

Site description. The leaf-tailed gecko habitat is located north-west of the Mount Glorious township, within D'Aguilar National Park. The vegetation consists of subtropical rainforest (Regional Ecosystem 12.8.3. Complex notophyll



FIG. 2. The initial site showing a large Strangler Fig Tree (*Ficus* sp.) growing on a rocky, western facing slope with little understorey. Several leaf-tailed geckos were observed on this tree. (Image: Ben Revell).

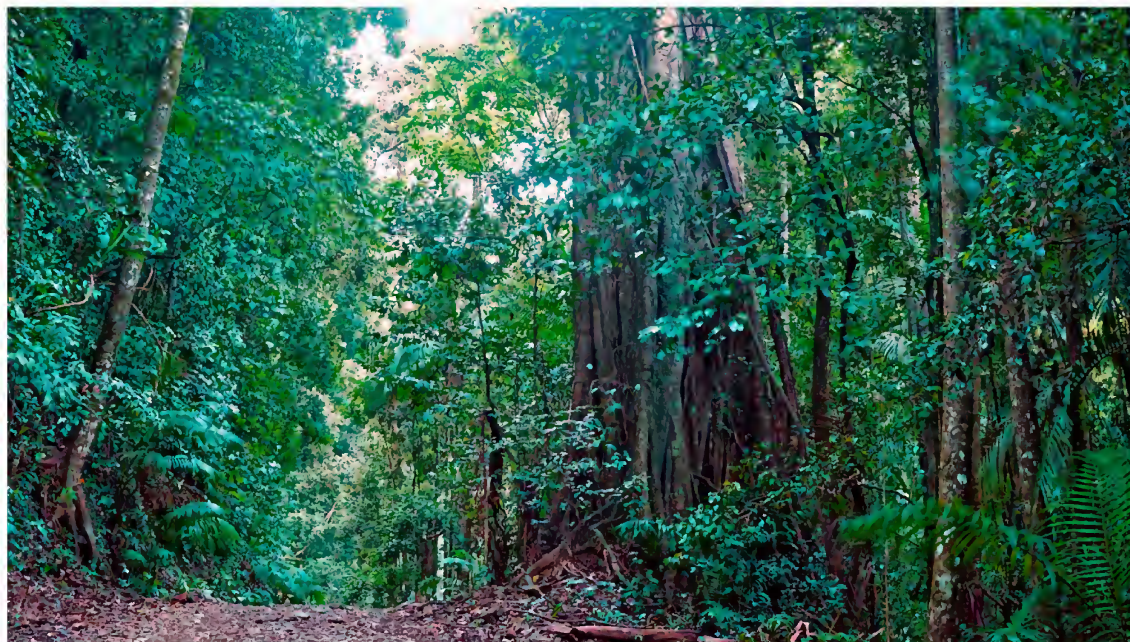


FIG. 3. The second leaf-tailed gecko site, approximately 2 km from the initial site, showing a large Strangler Fig (*Ficus* sp.) on which two geckos were seen. This site has a well-developed understorey and no surface rock. (Image: Ben Revell).

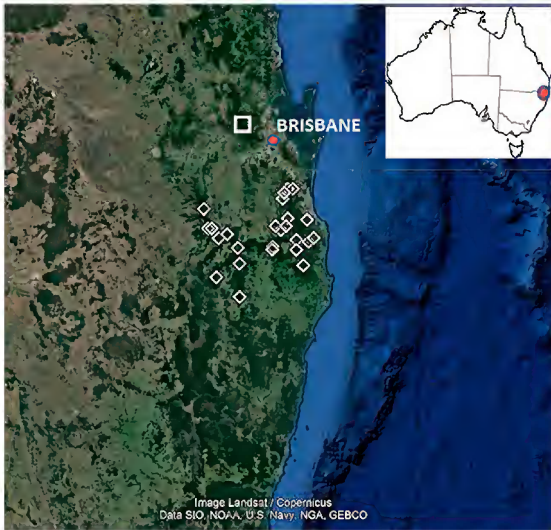


FIG. 4. Known distribution of *S. swaini*. The square symbol shows the Mt Glorious population which is widely disjunct from the populations to the south (diamond symbols; see Couper *et al.* 2008). Inset shows general region on map of Australia. Background map - Google Earth.

vine forest on Cainozoic igneous rocks. Altitude <600 m; Queensland Herbarium 2016) which extends for several kilometres on either side of the main Mt Glorious ridgeline. The initial site has a relatively open, sparse understorey on a jumbled rocky substrate comprised of Oligocene basalt that caps the Mt Glorious plateau, extending approximately 500 m (Willmott & Stevens 2005). At this site, the core habitat is a particularly rocky area (rocks to about one metre in circumference; Fig. 2) extending approximately 200 m by 100 m on a western facing slope. A second site, approximately 2 km from the first, is also on a western slope descending from the same ridgeline as the first. Whilst this site also has subtropical rainforest with large fig trees, it has a well-established understorey and no surface rock (Fig. 3).

Genetics. Two samples from Mt Glorious were sequenced for a section of cytochrome b mtDNA (as per Hoskin *et al.* 2003) and aligned against sequences available on GenBank (*S. swaini*: EU625318, EU625319 and EU625320 from Main Range; EU625323 from Tamborine Mountain;

EU625322 from Lamington NP; EU625324 from Mt Warning; EU625326 from Border Ranges; *S. wyberba* Couper, Schneider & Covacevich, 1997: EU625333; *S. salebrosus* (Covacevich, 1975): EU625341). Based on 360 base pairs, the two Mt Glorious samples are closely allied to *S. swaini* but sit outside of all other *S. swaini* sequences at an average divergence of 4.1% (C. Hoskin, unpub. data). Excluding Mt Glorious, average sequence divergence amongst the sites within *S. swaini* is just 1.0%. The Mt Glorious samples were 15.8% and 21.8% divergent from *S. wyberba* and *S. salebrosus*, respectively. Although only nine *S. swaini* sequences were included in this analysis, these come from sites across much of the species' range. The genetic data illustrates that the Mt Glorious population is *S. swaini*. *Saltuarius swaini* occurs in the coastal ranges of southeast Queensland and northern NSW (between latitudes 27° 53' S–28° 48' S). The closest *S. swaini* populations to Mt Glorious are on Mt Tamborine, ~80 km to the south-east (Fig. 4) and Main Range National Park, a similar distance to the south-west. The genetic divergence of 4% strongly suggests that this is a natural population that has been isolated from other *S. swaini* populations for an extended period. Using a coarse molecular clock for protein-coding mtDNA (Borsboom *et al.* 2010; Moritz *et al.* 2000), it is estimated that this population has been isolated for more than one million years.

DISCUSSION

It is remarkable that *Saltuarius swaini* has not previously been detected on Mt Glorious. The rainforests of Mt Glorious are amongst the most visited in south-east Queensland, being easily accessible and in close proximity to Brisbane. They are home to a rich fauna of nocturnal vertebrates and have been the focus of frequent night-driving and head-torching activities. In other areas of south-east Queensland (for example the Border Ranges, Lamington NP) leaf-tailed geckos are commonly encountered on roads and walking tracks. The Mt Nebo to Mt Glorious drive is particularly popular amongst reptile enthusiasts because nocturnal snakes and other reptiles are often encountered

on the roads. These forests have also been heavily investigated during targeted, long-term, field studies, one which Conrad Hoskin participated in, surveyed rainforest frogs on a rainforest stream transect in the headwaters of Love Creek, about 3 km north of the Mount Glorious township. Many surveys were conducted over five years (1996–2000) and all vertebrates were targeted both on the stream transect and on the walk through rainforest to and from the site. Similarly, Tony Hiller, a keen naturalist and long-term resident of Mt Glorious (~40 years), has no records of leaf-tailed geckos from this area. Nor does Wil Buch, a Queensland Parks and Wildlife Service ranger who resided on Mt Glorious for seven years and led an average of two guided night walks per week during this time, but not in the precise area where leaf-tailed geckos are now known. Co-author, Steve Wilson lived on Mt Nebo for 12 years and frequently drove the roads and head-torched in the forests at night. That no leaf-tailed geckos were seen during these activities, and activities by many other wildlife enthusiasts over the years, suggests a very limited occurrence on Mt Glorious. We initially thought this could indicate that the geckos had been recently introduced, but the genetic data strongly suggest a natural population. The Mt Glorious population is genetically distinct from likely source populations (Mt Tamborine, Lamington NP, Main Ra.); indeed the genetic divergence (4%) is greater than that seen amongst all other *S. swaini* populations sequenced.

There are currently no known records from the more frequently visited eastern side of the range, which includes the walking tracks originating from Maiala Picnic Ground. The rainforest at Maiala is continuous with that at the leaf-tailed gecko sites and to all purposes, appears to be ideal leaf-tailed gecko habitat, with numerous fig trees and other large trees with hollows and epiphytes in which to shelter. The same is true of the rainforest at Boombana Picnic Area on Mt Nebo, albeit with a much smaller rainforest extent in that area. Yet, in view of the aforementioned activities, leaf-tailed geckos appear to be absent from both these areas. Given the very recent discovery at

Mt Glorious, however, their presence elsewhere in the D'Aguilar Range cannot be ruled out, particularly in other pockets of rockier habitat around Mt Glorious. The occurrence of leaf-tailed geckos in other areas of the D'Aguilar Range warrants further investigation with targeted searches of suitable habitat.

The abundance of rock at the first leaf-tailed gecko site could be seen as significant and as having a role in preserving this species in historically drier times, due to the cooler, moister conditions provided by layered rock habitats (see Couper & Hoskin 2009). However, the geckos are not found directly on the rocks but rather occur on the fig trees growing amongst them. Additionally, as pointed out above, the second site (two kilometres away) is not rocky and once again the geckos occur on the fig trees (although surveys around this site could reveal nearby rocky habitat). Given this apparent preference for trees, it seems odd that they don't occur more widely through the rainforests on both Mt Nebo and Mt Glorious. Perhaps rocky areas provided an important refuge in the past, but then one would expect the geckos to have expanded back out of these areas over thousands of years to recolonise the surrounding well-developed rainforest. It is interesting to note that the Marsupial Frog, *Assa darlingtoni* (Loveridge 1933), another rainforest endemic of south-east Queensland and north-east New South Wales, also has a very patchy distribution on Mt Glorious. This species occurs in moist gullies and rocky slopes on Mt Glorious, including the rocky leaf-tailed gecko site. Although other areas of Mt Glorious appear to currently provide suitable habitat for *S. swaini* and *A. darlingtoni*, it may be the drier times during the evolutionary history of these forests that shaped the fine-scale distributions of these low vagility rainforest species.

The discovery of leaf-tailed geckos adds to the herpetological diversity known for Mt Glorious, which now includes eight wet-forest associated reptiles (*S. swaini*, *Bellatorias major* (Gray, 1845) *Karma murrayi* (Boulenger, 1887), *Lampropholis couperi* Ingram, 1991, *Saproscincus rosei* Wells & Wellington, 1985, *Lophosaurus spinipes* (Duméril & Duméril, 1851) *Hoplocephalus stephensii* Krefft,

1869 and *Tropidechis carinatus* (Krefft, 1863)) and five frogs (*Assa darlingtoni*, *Taudactylus diurnus* Straughan & Lee, 1966, *Litoria chloris* (Boulenger, 1893), *Litoria pearsoniana* (Copland, 1961) and *Mixophyes fasciolatus* Günther, 1864). This herpetofauna is broadly similar to, but impoverished, compared to that of the larger southern rainforest blocks of the Border and Main Ranges. Of the wet-forest obligate species, *Coeranoscincus reticulatus* (Günther, 1873), *Mixophyes fleayi* Corben & Ingram, 1987 and *Lechriodus fletcheri* (Boulenger, 1890) are present on the Border and Main Ranges but have not been recorded from the D'Aguilar Range (Mt Glorious). The apparent absence of *C. reticulatus* and *M. fleayi* is of particular interest as both species also occur in rainforests to the north, in the Sunshine Coast hinterland. Three species of *Saproscincus* (*S. rosei*, *S. challengerii* (Boulenger, 1887), and *S. spectabilis* (De Vis, 1888)) are found in the Border Ranges but only *S. rosei* occurs in the D'Aguilar Range. The Border Ranges also harbour two skinks that are restricted to higher elevations than are available in the D'Aguilar Range: *Karma tryoni* (Longman, 1918) and *Harrisoniascincus zia* (Ingram & Ehmann, 1981). Additionally, both the Border and Main Ranges support a frog belonging to the genus *Philoria* Spencer, 1901: *P. loveridgei* Parker, 1940 on the Border Range and *P. kundagungan* (Ingram & Corben, 1975) on the Main Range. As for the other species listed above, no *Philoria* are known from the D'Aguilar Range. Conversely, two elements of the D'Aguilar Range rainforest herpetofauna are not found in other rainforests where *S. swaini* occurs. The skink *Lampropholis couperi* is common on both Mt Nebo and Mt Glorious (and ranges to the north), and the frog *Taudactylus diurnus* was present on Mt Glorious (and ranges to the north) until its likely extinction in the 1970s. With the addition of *S. swaini* to the Mt Glorious faunal list, it is conceivable that *C. reticulatus* and some of the other species 'missing' from its rainforest herpetofauna, will also be found in the D'Aguilar Range with continued search effort.

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